NORTHEAST ELECTRONICS

INSTRUCTION MANUAL

Airport Road, Concord, New Hampshire 03301 • (603) 224-6521

A Division of Northern Telecom, Inc.

MODEL TTS-77

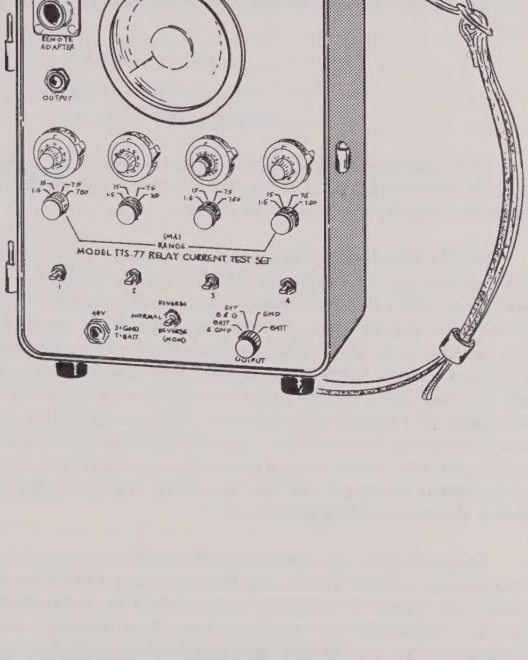
RELAY CURRENT TEST SET

ISSUE 1

DEC 1974

A0077-00-600

PRINTED IN U.S.A.



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SECTION 1

DESCRIPTION

1.1 INTRODUCTION.

1.2 The Northeast Electronics Model TTS 77 Relay Current Flow Test Set is a portable, solid-state unit designed to test and adjust electromechanical relays. The unit acts as an adjustable current source that is placed in series with the relay under test. Four independent current levels can be set, locked and then selected by front panel or remote switches. Output current is accurately monitored on a 250-degree meter with a knife edge needle and mirror. The unit can be used to monitor or set current levels that correspond to the operate, non-operate, release and hold performance specifications of a relay. The TTS 77 is provided with a remote control cable and a 4-foot test cable, both stored in the cover.

SECTION 2

SPECIFICATIONS

2.1 INTRODUCTION.

2.2 Table 2–1 lists the specifications for the TTS 77.

Table 2–1. Specifications.

ELECTRICAL	
Meter Ranges	1.5, 15, 75 and 750 milliamperes full scale.
Accuracy	±2% full scale all ranges.
Tracking	±1.5% full scale all ranges.
Regulation	7 volts ⩽ Vr ⩽ 56 volts, ±4% full scale all ranges. 10 volts ⩽ Vr ⩽ 56 volts, ±2% full scale all ranges.
Power Dissipation	30 watts maximum at 0°C (+32°F), 20 watts maximum at 25°C (+77°F), 10 watts maximum at 50°C (+122°F), Self protecting.
Power Input (48V)	−42 volts to −56 volts at 780 milliamperes maximum.
MECHANICAL	
Overall Dimensions	9 in. h x 7 in. w x 6 in. d (22.9 cm x 17.8 cm x 15.3 cm) with cover.
Weight	6 lb. (2.72 kg.).
Remote Control	Five momentary switches for remote control of test relays for the four current circuits and NORMAL-REVERSE.
Test Leads	A 4-foot cable with a 310-type connector on one end and two alligator clips on the other end.
ENVIRONMENTAL	
Ambient Temperature	0°C (+32°F) to +50°C (+122°F).
Relative Humidity	30% to 90%.

SECTION 3

OPERATING INSTRUCTIONS

3.1 **INTRODUCTION.**

3.2 Table 3—1 lists the function of the controls, indicators and connectors shown on Figure 3—1, with their reference designators. Paragraphs 3.3 through 3.19 provide the necessary information for the operation of the TTS 77.

Table 3—1. Front Panel Controls, Indicators and Connectors.

REF DESIG	CONTROL, INDICATOR OR CONNECTOR	FUNCTION
J1	48V jack	Type 310 connector for 48 volt power source.
J2	OUTPUT jack	Type 310 connector for access to current regulator.
J3	REMOTE ADAPTER	Adapter for remote control pushbuttons used to control test switch relays and NORMAL-REVERSE relay.
M1	Meter	Indicates current being supplied to relay under test.
R21-R24	Current adjust controls	High-resolution, 10-turn potentiometer used to set four independent output currents.
S1-S4	Test switches	Selects the current circuit to be used with relay under test.
S5	NORMAL-REVERSE switch	Reverses polarity of OUTPUT connector J2.
S6-S9	RANGE switches	Selects meter range of 1.5,15,75 or 750 milliamperes for each current circuit.
S10	OUTPUT switch	Establishes correct battery and ground connections for relay configuration to be tested. In the BATT & GND position, the regulator and relay under test are connected in series and operated from the same office battery used to power the TTS 77 internal relays. In the EXT B & G position, the regulator and relay under test are operated in series with an external battery and ground supply. In the GND position, a ground connection is made through the current regulator to one side of the output jack. The relay under test is connected between the output jack and an external battery supply (not to exceed —56 volts). In the BATT position, the office battery is connected through the current regulator to one side of the output jack. The relay under test is connected between the out put jack and an external ground.

3.3 **RELAY PERFORMANCE REQUIREMENTS.**

3.4 Operate. When the operate value of current flow (specified in the relay adjustment sheet) is applied through the relay under test, the armature should move sufficiently to close all normally-open contacts and open all normally-closed contacts. If the relay does not operate within the test values in the operate column, adjust the relay.

3.5 Non-operate. When the non-operate value of current flow (specified in the relay adjustment sheet) is applied through the relay winding under test, the armature should not move sufficiently to close normally-opened contacts nor open normally-closed contacts. If the relay does operate within the test values in the non-operate column, adjust the relay.

3.6 Release. Reducing the current flow to the release value (specified in the relay adjustment sheet) should allow the relay to return to its non-operate position.

3.7 Hold. With the relay operated, reducing the current flow to the hold value (specified on the relay adjustment sheet) should allow the relay to remain in the operated position.

3.8 **PRESETTING OUTPUT CURRENTS.**

3.9 To preset the four output currents, perform the following:

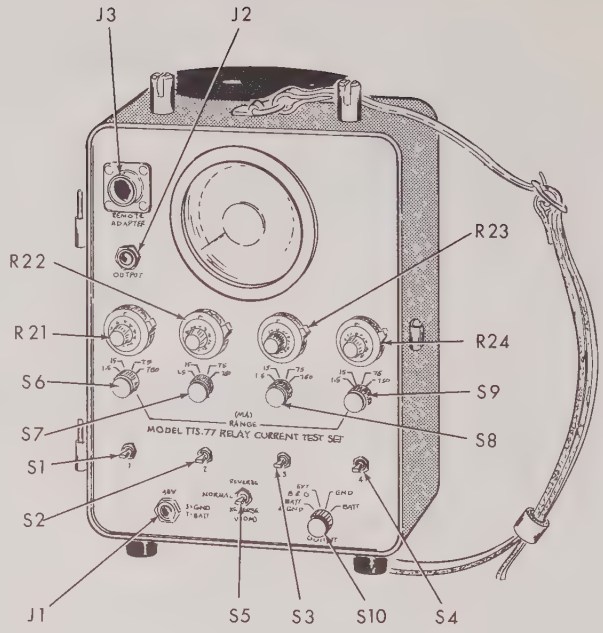

Figure 3—1. Controls, Indicators and Connectors.

NOTE

The TTS 77 was calibrated with the meter in the horizontal position. To obtain the specified accuracy, the instrument must be operated with the meter in the same position.

ACTION	RESULT
a. Set test switches S1-S4 to center position.	Disconnects RANGE switches from meter.
b. Set NORMAL-REVERSE switch to NORMAL.	
c. Insert 310-type plug and cable (customer supplied) into 48V jack, J1.	
d. Attach other end of cable to —48 volts. S = GND, T = BATT.	Applies —48 volts to instrument.
e. Set OUTPUT switch to GND position.	
f. Insert 4-foot Northeast Electronics-supplied relay test cable to OUTPUT jack J2.	
g. Connect red lead of relay test cable to a load relay.	Provides current path for setting up current adjust controls R21-R24.
h. Set corresponding RANGE switch to desired range.	

ACTION	RESULT
i. Set number 1 test switch to up position.	Connects RANGE switch S6 and current adjust control R21 to regulator.
j. Adjust current control R21 to obtain desired current level.	Sets output current to desired level.
k. Repeat steps g through j to set the three remaining current circuits, R22 to R24.	Sets output current to desired level.

3.10 **OPERATING INSTRUCTIONS.**

3.11 The operating procedures described in the following paragraphs are not intended to limit the operator in using the full capabilities of the TTS 77 test set. Familiarity with the operating features described previously will permit variations in procedures to accommodate known test requirements.

3.12 Refer to the relay adjustment specifications, supplied with relays, and paragraphs 3.8 and 3.9 to preset the specified current levels for the operate, hold, release and non-operate conditions of the relay under test.

3.13 **TESTING SINGLE-WOUND RELAYS.**

3.14 To test single-wound relays perform the following steps:

NOTE

Before proceeding with any test, determine the electrical configuration of the relay with respect to battery and ground. Refer to Figure 3—2.

ACTION	RESULT
a. Preset currents to relay performance requirements, refer to paragraphs 3.8 and 3.9.	
b. Insulate the contacts that control the relay.	Isolates coil access terminals of relay.
c. Set OUTPUT switch to GND or BATT position as required.	
d. Connect black alligator clip to relay coil access terminal for grounded relay test, or red alligator clip for battery relay tests. Refer to Figure 3—2.	Supplies —48 volts for a grounded relay or ground for a battery relay, through current regulator to relay under test.
e. Set appropriate test switch that will be used to supply non-operate current to up position.	Applies non-operate current to relay under test. Relay should not operate.
f. Return test switch to center position.	Removes non-operate curent from relay.
g. Set appropriate test switch that will be used to supply operate current to up position.	Applies operate current to relay under test. Relay should operate.
h. Set appropriate test switch that will be used to supply hold current to up position and then return operate current test switch to center position.	Applies hold current to relay under test and then removes operate current. Relay should remain operated.

ACTION	RESULT
i. Set appropriate test switch that will be used to supply release current to up position and then return hold current test switch to center position.	Applies release current to relay under test and then removes hold current. Relay should release.
j. Return release current test switch to center position.	Removes release current from relay under test.

3.15 **TESTING DOUBLE-WOUND RELAYS.**

3.16 To test double-wound relays perform the following:

ACTION	RESULT
a. Preset currents to relay performance requirements, refer to paragraphs 3.8 and 3.9.	
b. Insulate contacts that control relay under test.	Isolates coil access terminals of relay.
c. Set OUTPUT switch to EXT B&G position.	
d. Connect black alligator clip to grounded coil and red alligator clip to battery supplied coil.	Uses external office battery and ground to test double-wound coil.
e. Set appropriate test switch that will be used to supply non-operate current to up position.	Applies non-operate current to relay under test. Relay should not operate.
f. Return non-operate test switch to center position.	Removes non-operate current from relay.
g. Set appropriate test switch that will be used to supply operate current to up position.	Applies operate current to relay under test. Relay should operate.
h. Set appropriate test switch that will be used to supply hold current to up position and then return operate test switch to center position.	Applies hold current to relay under test and then removes operate current. Relay should remain operated.
i. Set appropriate test switch that will be used to supply release current to up position and then return hold test switch to center position.	Applies release current to relay under test and then removes hold current. Relay should release.
j. Return release current test switch to center position.	Removes release current from relay.

3.17 By placing the OUTPUT switch in the BATT position, only the grounded coil is in the circuit and the battery coil is in effect shorted out. The battery-supplied coil is tested singularly when the switch is in the GND position.

3.18 **TESTING POLAR RELAYS.**

3.19 To test polar relays perform the following steps:

ACTION	RESULT
a. Preset currents to relay performance requirements, refer to paragraphs 3.8 and 3.9.	
b. Insulate contacts that control relay.	Isolates coil access terminals of relay.
c. Set OUTPUT switch to BATT & GND position.	
d. Connect red and black alligator clips to terminals of polar relay.	Supplies −48 volts and ground to polar relay coil.
e. Set appropriate test switch that will be used to supply non-operate current to up position.	Applies non-operate current to relay under test. Relay should not operate.
f. Set NORMAL-REVERSE switch to REVERSE position.	Reverses OUTPUT current. Relay should not operate in reverse direction.
g. Return non-operate test switch to center position.	Removes non-operate current from relay.
h. Set appropriate test switch that will be used to supply operate current to up position.	Applies operate current to relay under test. Relay should operate.
i. Set NORMAL-REVERSE switch to NORMAL position.	Reverses OUTPUT current. Relay should switch and operate.
j. Return operate current test switch to center position.	Removes operate current from relay.

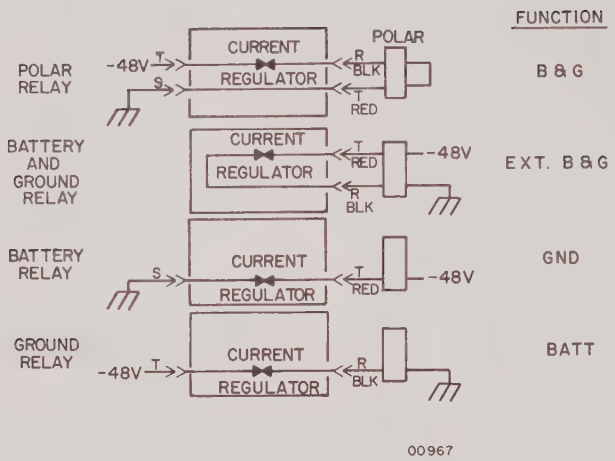

Figure 3—2. Relay Test Configurations.

SECTION 4

CIRCUIT DESCRIPTION

4.1 INTRODUCTION.

4.2 Paragraphs 4.3 through 4.14 with schematic diagram, Figure 7—1 provide circuit descriptions for the Model TTS 77.

4.3 REFERENCE CURRENT.

4.4 A reference current of 200 microamperes is maintained with FET Q3. This current provides a reference voltage at the base of Q1, one side of a differential amplifier, through test switches S1,S2, S3 or S4 depending on the current circuit used. A strap is provided, to be replaced by an ammeter to monitor the reference current during calibration. Potentiometer R12 is used to adjust the current. The reference current flows through selected current adjust potentiometer, either R21, R22,R23 or R24. The voltage at the wiper is used as a reference voltage.

4.5 AMPLIFIERS.

4.6 A differential amplifier, comprised of transistors Q1 and Q2, operates with three stages of current gain provided by transistors Q4,Q5 and Q6 to maintain the voltage across the emitter resistors of Q6 equal to the reference voltage at the base of Q1. The output current is therefore dependent upon the reference voltage and the emitter resistor selected. The emitter resistors are selected by front panel RANGE switches S6 through S9. One RANGE switch is associated with each test switch. In the 1.5 milliampere range the Q6 emitter resistors are R1 and R2, in the 15 milliampere range they are R3 and R4, in the 75 milliampere range they are R5 and R6 and in the 750 milliampere range the emitter resistors are R7 and R8.

4.7 CURRENT CONTROL.

4.8 The current circuit to be monitored by meter M1 is selected with test switches S1 through S4, which operate corresponding relays K1 through K4. RANGE switches, S6 through S9, are rotary switches that select the current range to be used. Resistors R21 through R24 are 10 turn potentiometers used to adjust the OUTPUT currents within the limits of their corresponding RANGE switches. In the 1.5 milliampere position, relay K6 operates and opens the Q6 collector path to prevent leakage current through meter M1. In the 15,75 and 750 milliampere ranges, the 200 microampere reference current is applied through meter M1.

4.9 METER CIRCUIT.

4.10 The voltage developed across the selected emitter resistor is measured by meter M1 through series resistor R9 and shunt resistors R10 and R11. Two diodes, CR9 and CR10, provide over voltage protection for the meter. The meter is calibrated in milliamperes and indicates the OUTPUT current.

4.11 NORMAL-REVERSE AND REMOTE CONTROL.

4.12 Current circuits 1 through 4 can also be selected by the remote control switch connected to J3, the remote adapter. The NORMAL-REVERSE relay can also be controlled by the remote control switch. The NORMAL-REVERSE relay is controlled by front panel switch S10. Relay K5 reverses the leads to the OUTPUT jack J2

4.13 THERMAL PROTECTION.

4.14 Power transistors Q5 and Q6 are automatically protected from damage due to overheating by thermal switch S11 mounted on the same heatsink. The switch operates and removes power from the regulator when the heatsink temperature exceeds +80°C (+176°F). When the heatsink cools to approximately +70°C (+158°F), the switch releases and power to the regulator is restored.

SECTION 5

MAINTENANCE AND CALIBRATION

5.1 **INTRODUCTION.**

5.2 The Model TTS 77 does not require routine preventive maintenance. This section, therefore, provides only the information and instructions necessary to calibrate the test set.

5.3 **SERVICE INFORMATION.**

5.4 Each instrument manufactured by Northeast Electronics is warrented for a period of one year upon delivery to the original purchaser. Complete warrenty information is located on the rear of the title pate of this manual. Note that written authorization is required prior to the return of any equipment for factory repairs. Additional service information can be obtained by contacting Northeast Electronics, Customer Service Department, P.O. Box 649, Concord, New Hampshire, 03301, telephone number 603-224-6521.

5.5 **TEST EQUIPMENT.**

5.6 The only test instrument required is a dc ammeter with an accuracy of 0.1% or better and capable of measuring current from 1.5 to 750 milliamperes.

5.7 **CALIBRATION.**

5.8 To calibrate the Model TTS 77, perform the following steps:

NOTE

The unit must be calibrated with the meter in the horizontal position.

ACTION	RESULT
a. Remove the four front panel screws and lift assembly from case.	
b. Set test switches S1 through S4 to neutral position.	Four current circuits are disconnected from neter.
c. Insert plug of power lead into J1, the 48 volt jack ,then connect other end to −48 volt supply.	Applies −48 volts to the instrument.
d. Insert the test lead plug into J2, the OUTPUT jack. Connect red alligator clip to negative lead of dc ammeter and black alligator clip to positive lead of dc ammeter.	
e. Set number 1 RANGE switch S6 to 750.	
f. Set number 1 test switch to up position.	Connects current circuit number 1 to OUTPUT jack J2 and meter M1.
g. Adjust number 1 current control potentiometer R21 to obtain an indication of 750 milliamperes on external ammeter.	
h. Lock potentiometer R21 and recheck current indication.	

ACTION	RESULT
i. Adjust potentiometer R11 to obtain indication of 750 milliamperes on meter M1.	Indication on meter M1 must be 750 milliamperes ±5.0 milliamperes (±1.0 meter divisions).
j. Unlock and readjust current control potentiometer R21 to obtain an indication of 75 milliamperes on external ammeter.	
k. Lock potentiometer R21 and recheck current indication.	
l. Set number 1 RANGE switch S6 to 75.	
m. Adjust potentiometer R6 to obtain indication of 75 milliamperes on meter M1.	Indication on meter M1 must be 75 milliamperes ±0.50 milliamperes (±1.0 meter divisions).
n. Unlock and readjust current control potentiometer R21 to obtain an indication of 15 milliamperes on external ammeter.	
o. Lock potentiometer R21 and recheck current indication.	
p. Set number 1 RANGE switch S6 to 15.	
q. Adjust potentiometer R4 to obtain indication of 15 milliamperes on meter M1.	Indication on meter M1 must be 15 milliamperes ±1.0 milliamperes (±1.0 meter divisions).
r. Unlock and readjust current control potentiometer R21 to obtain an indication of 1.5 milliamperes on external ammeter.	
s. Lock potentiometer R21 and recheck current indication.	
t. Set number 1 RANGE switch S6 to 1.5.	
u. Adjust potentiometer R2 to obtain an indication of 1.5 milliamperes on meter M1.	Indication on meter M1 must be 1.5 milliamperes ±0.010 milliamperes (±1.0 meter divisions).
v. Set number 1 test switch to neutral position.	Removes current circuit number 1 from OUTPUT jack J2 and meter M1.

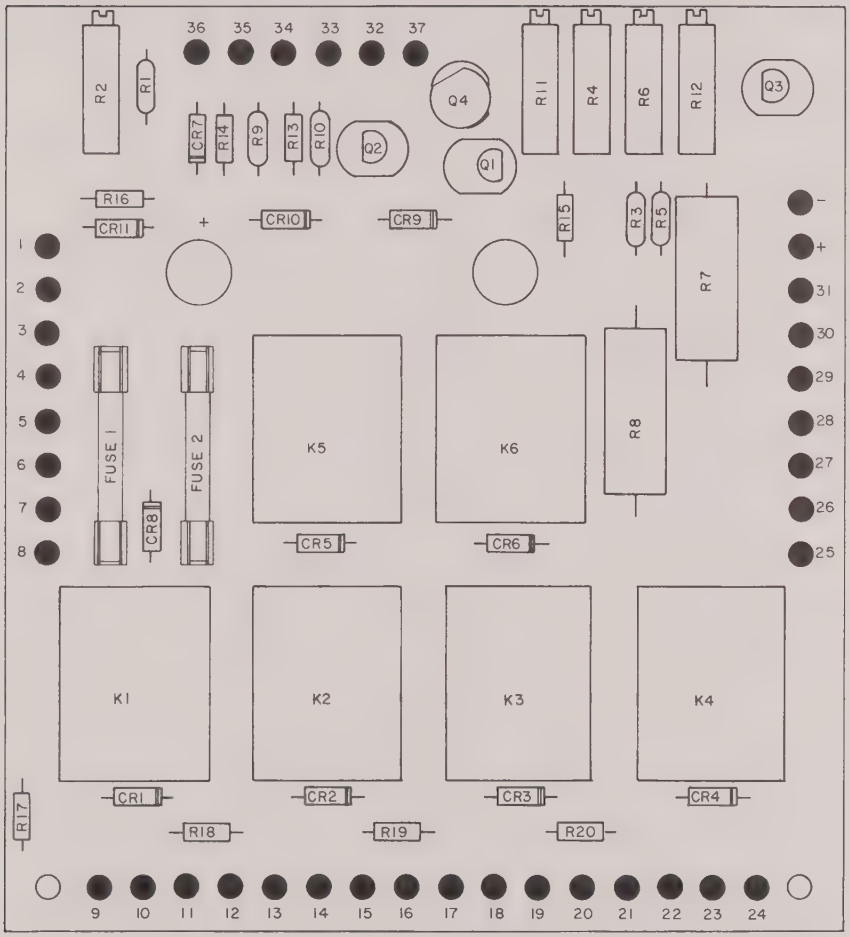

Figure 6—1. TTS 77 Circuit Board 96012 Component Location Diagram.

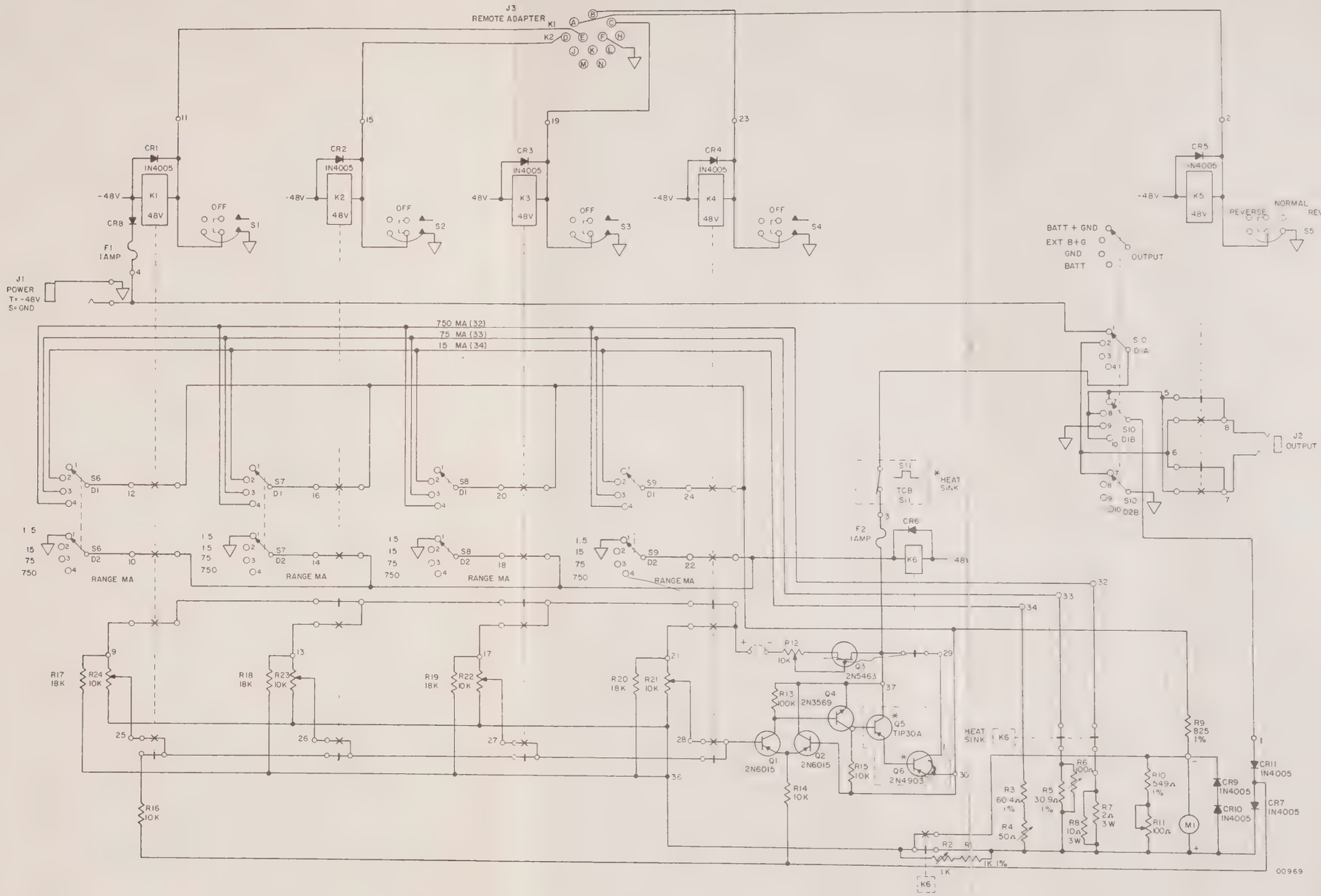

Figure 7—1. TTS 77 Overall Schematic Diagram.

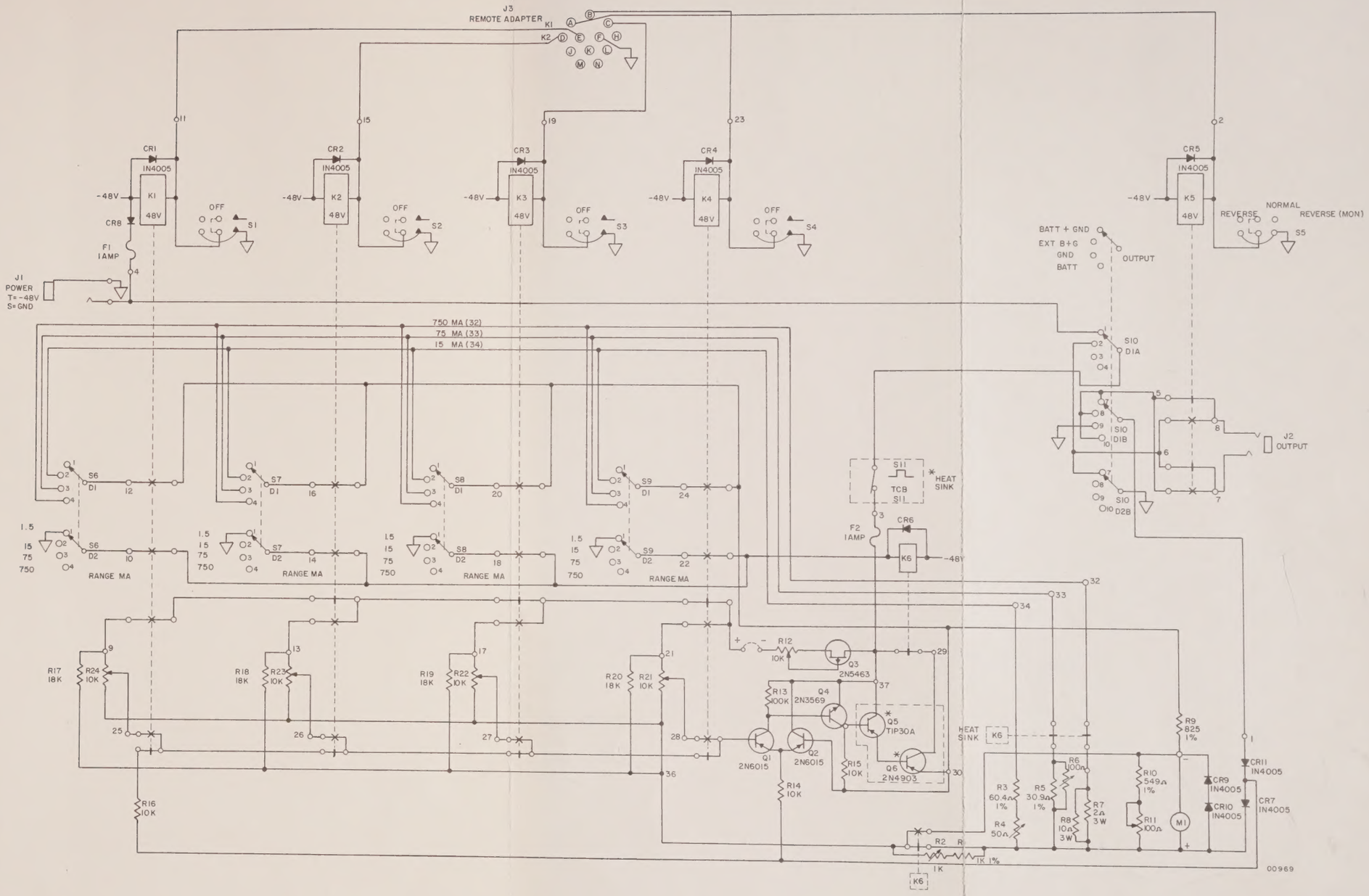

Figure 7—1. TTS 77 Overall Schematic Diagram.